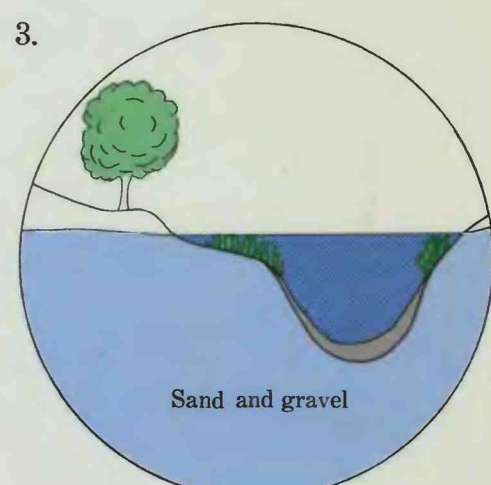


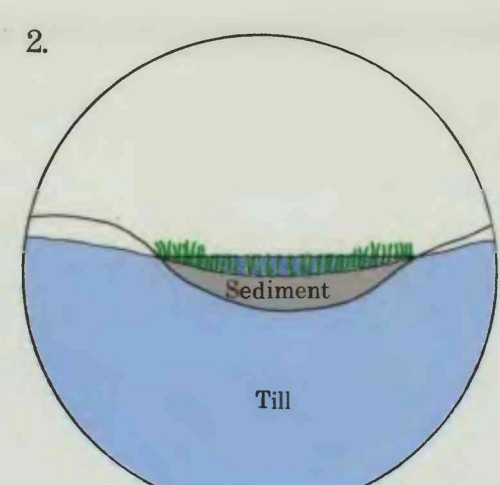
EXPLANATION



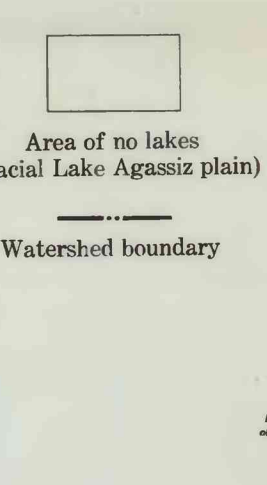
Area of lakes in very hilly, glacial moraine underlain by glacial till. Lakes are usually deep and have a thick accumulation of sediment on the bottom. Productivity (the total living organisms) in this type of lake is high and aquatic plants are usually abundant. The water table gradient is generally quite steep in the hills surrounding the lake because of the tightness of the till. This causes high potential but slow ground-water movement to the lake and is the reason for the occurrence of many springs surrounding these lakes.



Area of lakes in glacial ice-contact or outwash area underlain by sand and gravel. Lakes are usually quite deep, but have a lesser amount of sediment on the bottom than the lakes underlain by till. Productivity is high, but not as high as in lakes underlain by till and aquatic plants are usually less abundant. The water table is the level surrounding the lake is usually fairly flat because of the high permeability of the sand and gravel. Lakes in this setting are usually clear and have a good inter-connection with the ground-water system.



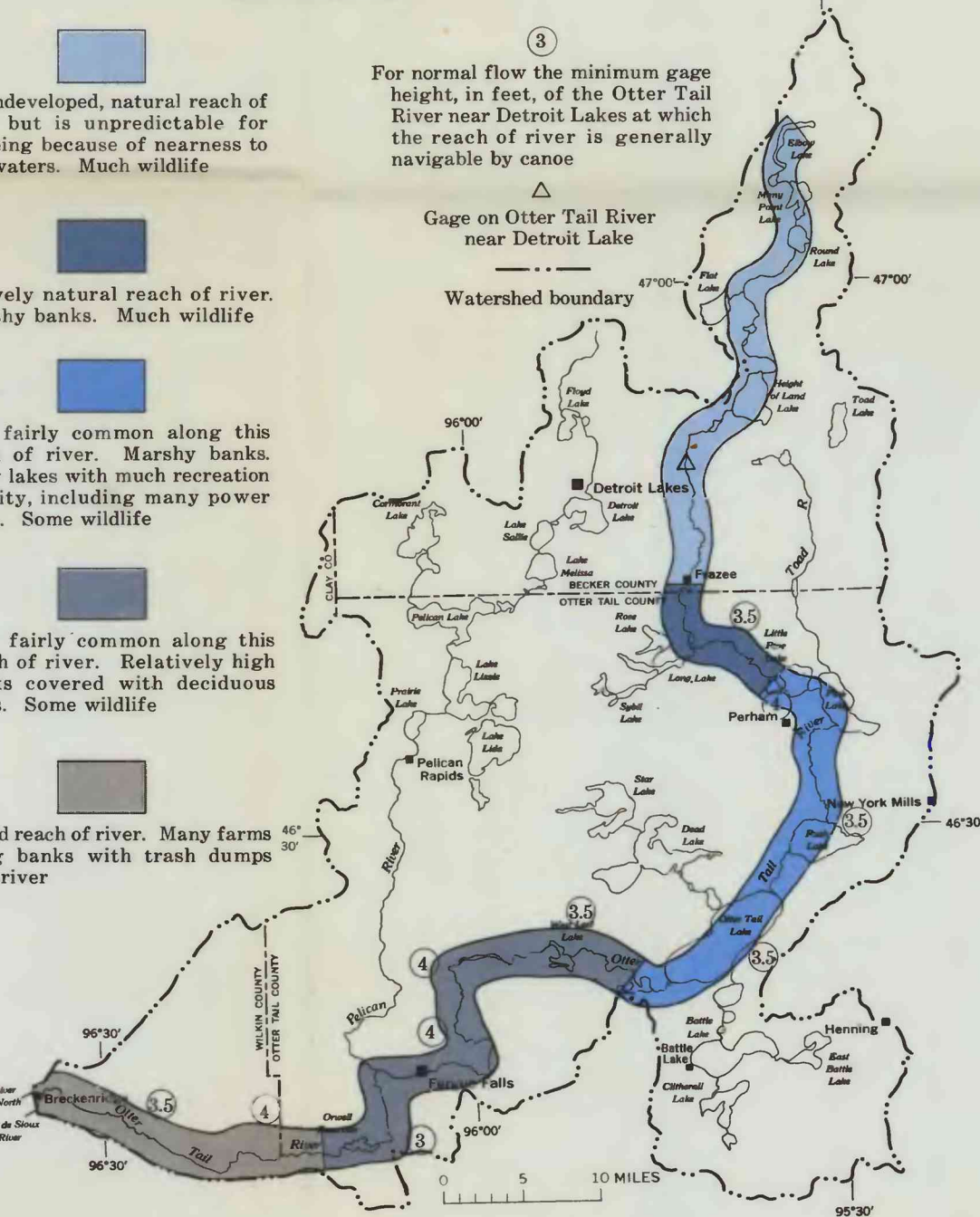
Area of lakes in gently rolling glacial moraine underlain by glacial till (grassy patches). Lakes and marshes are usually shallow and have a relatively large accumulation of sediment on the bottom. Productivity is extremely high and aquatic plants are usually very abundant. The water table gradient is generally quite steep in the hills surrounding the lake because of the tightness of the till. This causes high potential but slow ground-water movement to the lake and is the reason for the occurrence of many springs surrounding these lakes.



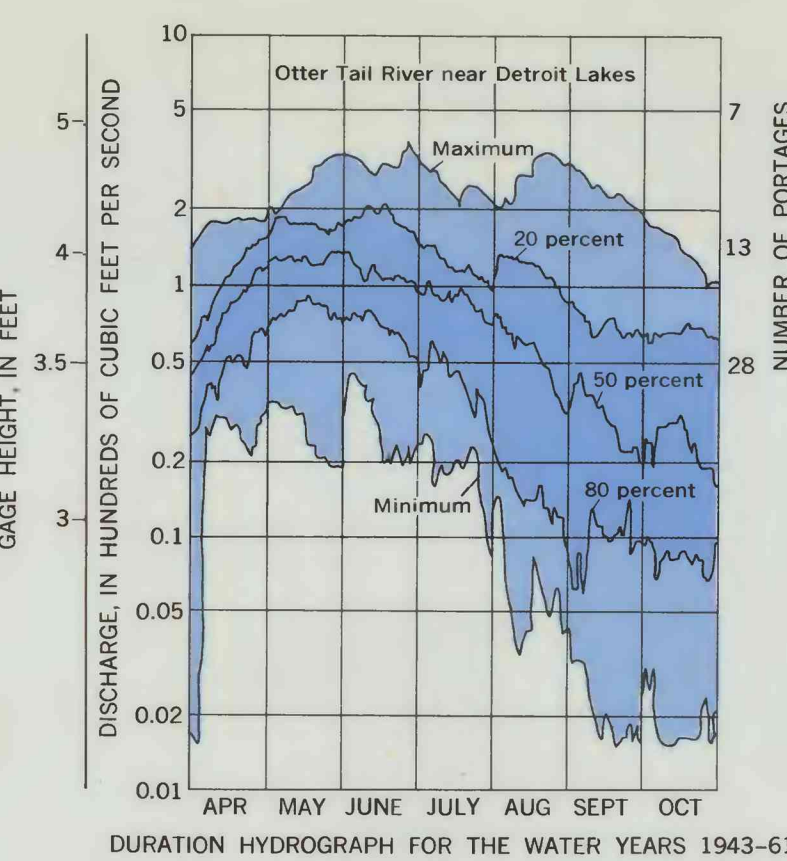
Area of no lakes (Glacial Lake Agassiz plain). Lakes and marshes are usually shallow and have a relatively large accumulation of sediment on the bottom. Productivity is extremely high and aquatic plants are usually very abundant. The water table gradient is generally quite steep in the hills surrounding the lake because of the tightness of the till. This causes high potential but slow ground-water movement to the lake and is the reason for the occurrence of many springs surrounding these lakes.

LAKES IN THE OTTER TAIL WATERSHED CAN BE CLASSIFIED BY THEIR GEOLOGIC AND GEOMORPHIC SETTING INTO THREE BASIC TYPES: 1. LAKES IN VERY HILLY GLACIAL MORAINES UNDERLAIN BY GLACIAL TILL, 2. LAKES IN GENTLY ROLLING GLACIAL MORAINES UNDERLAIN BY SAND AND GRAVEL, AND 3. LAKES IN ICE-CONTACT AND OUTWASH AREAS UNDERLAIN BY SAND AND GRAVEL. This is a general classification and there are many intermediate types and mixing of types within the areas shown. Although lakes are influenced by climate, vegetation, and chemical and biological characteristics of the water one of the basic controls is the relation of the lake basin to the ground-water system.

EXPLANATION



THE OTTER TAIL RIVER IS VERY FAVORABLE FOR CANOEING THROUGHOUT MOST OF ITS LENGTH. The large lakes can be dangerous at times because of large waves caused by sudden fluctuations and they are much used by power boats, but most interesting stretches of the river are very enjoyable for canoeing. Wildlife and birds are fairly abundant throughout most of its length. The river stage is most favorable for canoeing through June (See hydrograph). September and October are the only months when the stage height is generally less than 2.5 feet for more than 50 percent of the time. Downstream from Otwell Dam the river is polluted and has unsightly banks.



DAILY DURATION HYDROGRAPH SHOWS THAT THE OTTER TAIL RIVER NEAR DETROIT LAKES HAS A GAGE HEIGHT GREATER THAN 3.5 FEET (THE MINIMUM GAGE HEIGHT AT WHICH THE RIVER IS GENERALLY NAVIGABLE BY CANOE) OVER 80 PERCENT OF THE TIME FROM THE MIDDLE OF APRIL THROUGH JUNE. The occurrence of a gage height of 2.5 feet usually declines to 50 percent of the time by the middle of August and to about 10 percent of the time during September and October. Number of portages indicated on map for a canoe trip from Height of Land Lake to Broken-rider.

WATER RECREATION

EXPLANATION



RELATIVE USE OF LAKES  
Heavy use  
Greater than 50 percent of shoreline developed for resort and cabin use  
Moderate use  
Between 25 and 50 percent of shoreline developed for resort and cabin use  
Light use  
Less than 25 percent of shoreline developed for resort and cabin use

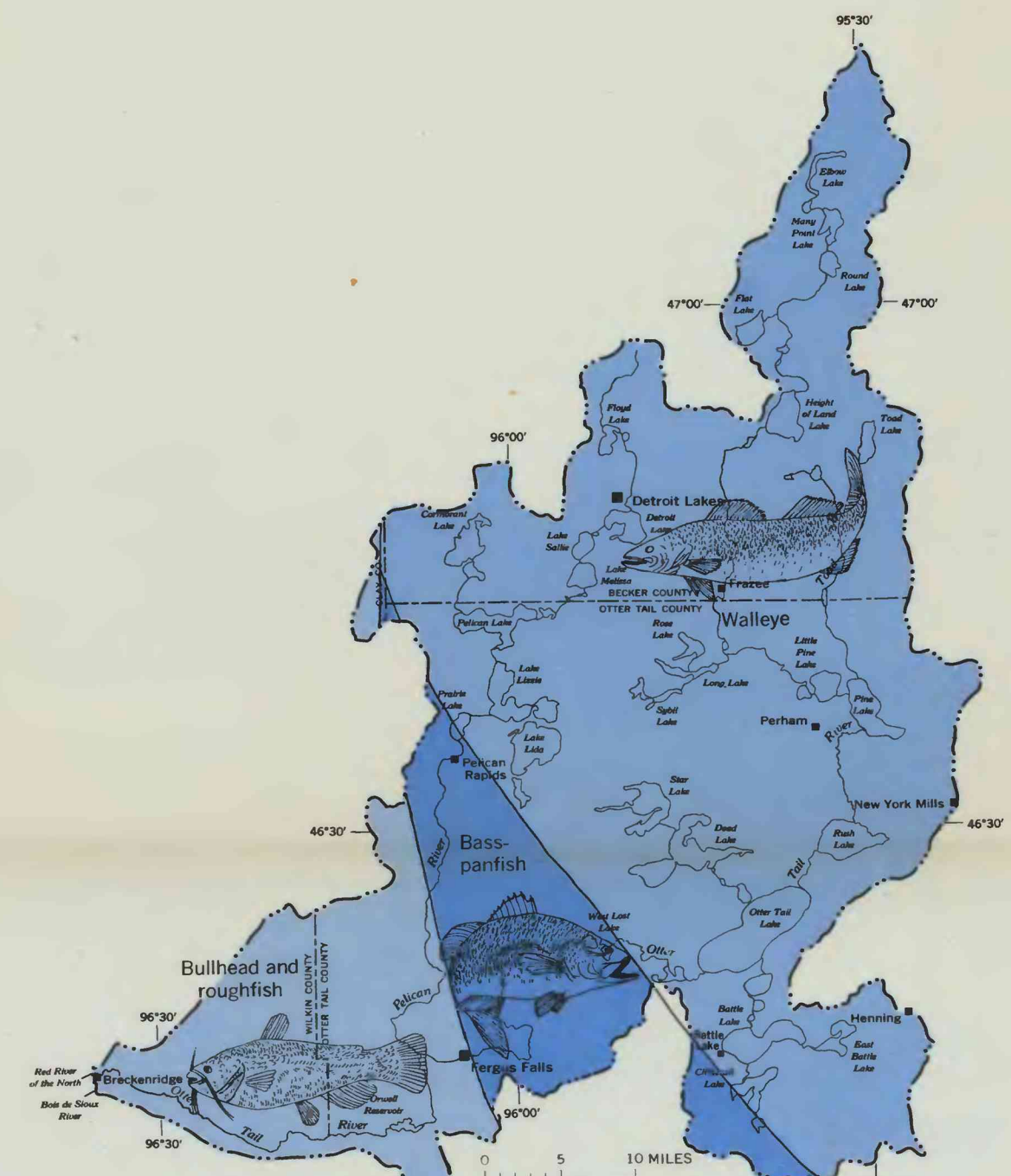


Tamarac National Wildlife Refuge  
State and local wildlife management area  
Game refuge  
Public boat access  
Principal highway  
Watershed boundary

Base from U.S. Geological Survey, 1:250,000 series: Grand Forks, 1952; Fargo, 1955; Ed. Bemidji, 1954-65; and Brainerd, 1953-65.

SCALE 1:250,000  
CONTOUR INTERVAL 50 FEET  
DATUM IS MEAN SEA LEVEL

5 10 15 20 25 MILES  
5 10 15 20 25 KILOMETERS



From Minnesota Department of Conservation, 1965

THE DISTRIBUTION OF FISH IS CONTROLLED BY THE SUITABILITY OF WATER AVAILABLE. Bullheads are most common in the clear water of the lakes with sand and gravel bottoms. Bass and panfish are most common in the highly productive lakes underlain by glacial till in the prairie and western woodland part of the watershed. Bullheads and roughfish are common in the Red River of the North and its tributaries.

From Minnesota Department of Conservation, 1965

WATERFOWL PRODUCTION VALUES ARE HIGH IN THE PRAIRIE AND THE WESTERN PART OF THE WOODLAND. This area is especially favorable for waterfowl because of the ideal nesting and feeding conditions provided by the prairie potholes (See lake classification). The woodlands are important to waterfowl production because the more permanent lakes provide alternate sites during periods when the potholes are dry.

From Minnesota Department of Conservation, 1965

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WATER RESOURCES OF THE OTTER TAIL RIVER WATERSHED, WEST-CENTRAL MINNESOTA

By  
T. C. Winter, L. E. Bidwell, and R. W. MacLay  
1969